



marineharvest



GLOBAL R&D
AND TECHNICAL

Genomic selection for PD resistance, what can we expect?

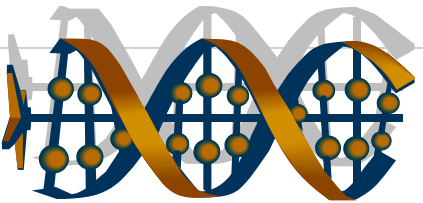


Genomics – a revolution in animal breeding?

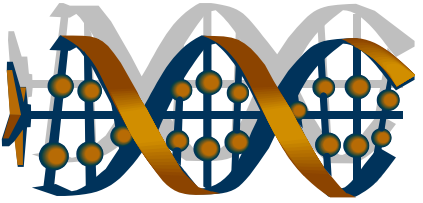
Major advances made in dairy and pig sector.

Can salmon aquaculture expect the same?

Use of markers to select best animals- Genomic selection (GS)



More resistant individual



More susceptible individual

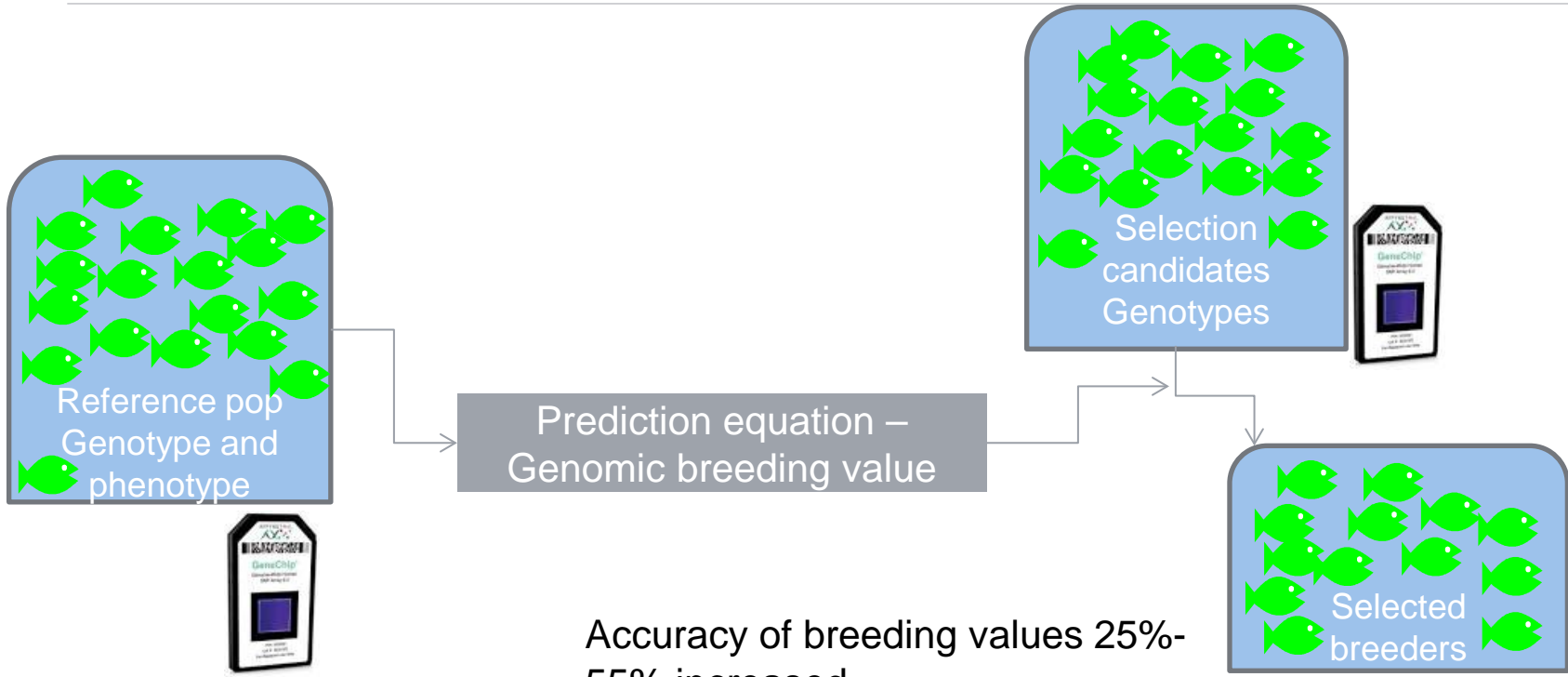


Genomic breeding values (GEBVs)

Generate marker genotypes by genotyping on array platform (SNP chip) or by sequencing.



Genomic selection in practice



Accuracy of breeding values 25%-55% increased.

- Allowing for selection within family
- Tracking minor QTLs with small effect

First need a phenotype.....

- › Started (2006) with field natural challenge.
- › Not reliable if mortality low.
- › Moved to smolt challenge test (intraperitoneal injection).
- › Now, fry (50 days post hatch) challenge model.
- › What is PD? Antibody titre, presence of virus, morbidity, stress response..?
- › Validate fry/smolt challenge model in the field.

Journal of **Fish Diseases**

Heritability of mortality in response to a natural pancreas disease (SPDV) challenge in Atlantic salmon, *Salmo salar* L., post-smolts on a West of Ireland sea site

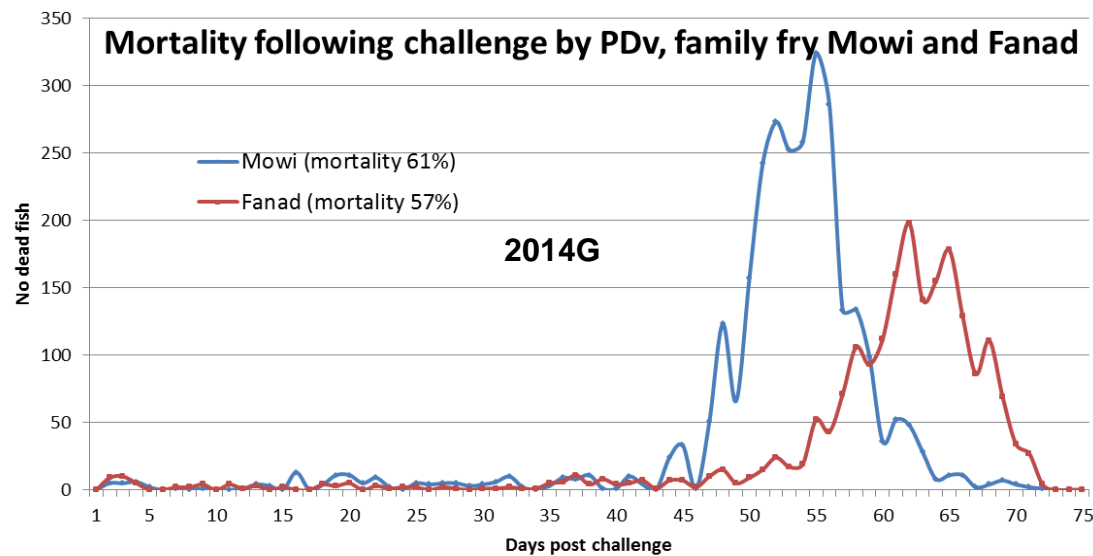
A Norris¹, L Foyle² and J Ratcliff¹

Issue

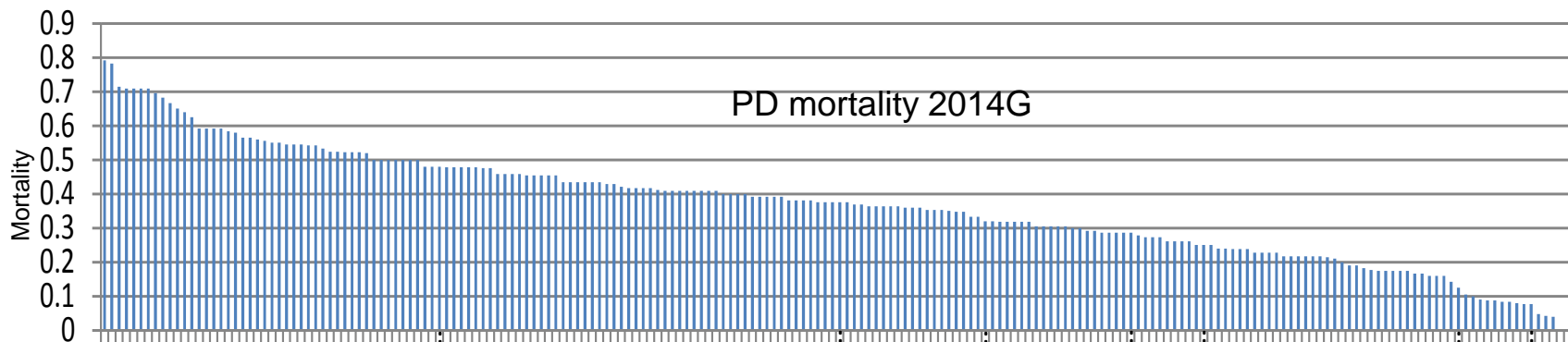


Journal of Fish Diseases
Volume 31, Issue 12, pages
913–920, December 2008

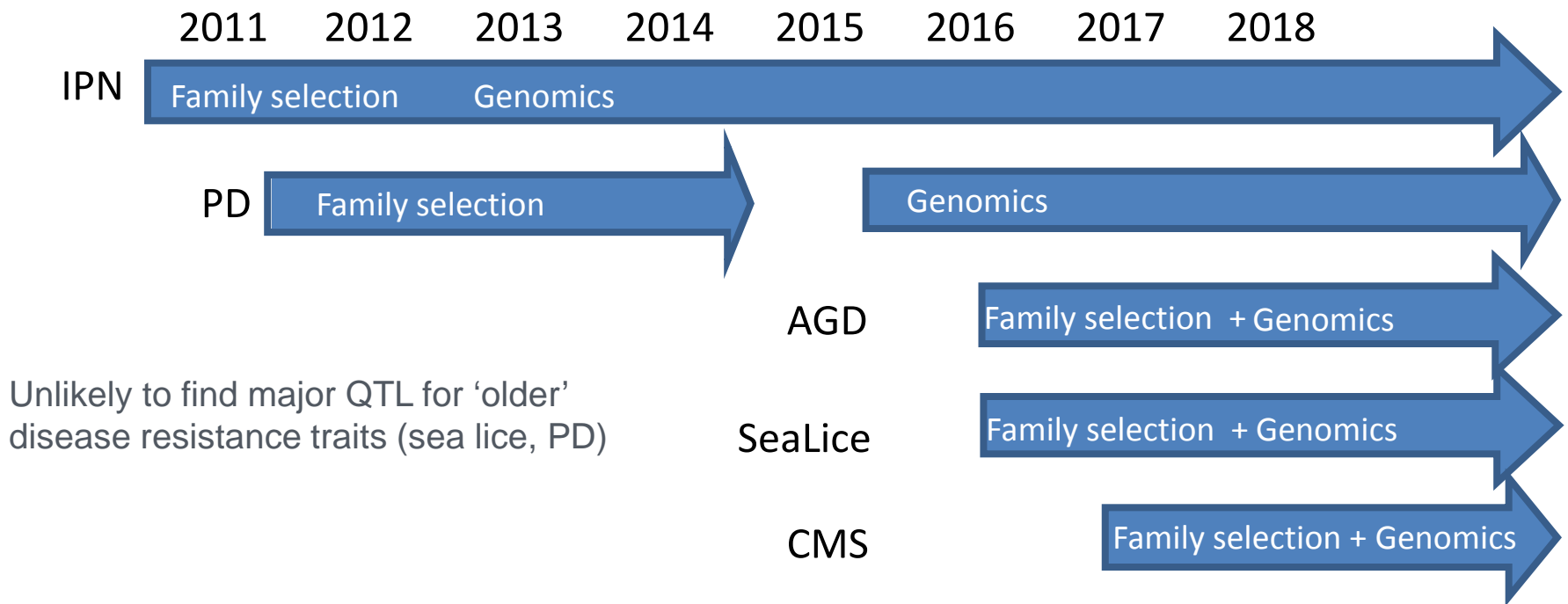
Genetic selection for PD resistance – fry challenge.



- › Heritability typically 0.17-0.35.
- › Can expect gain maximum 10-15% per generation.



Implementing disease resistance selection in MH breeding program



Genomic selection for PD resistance.

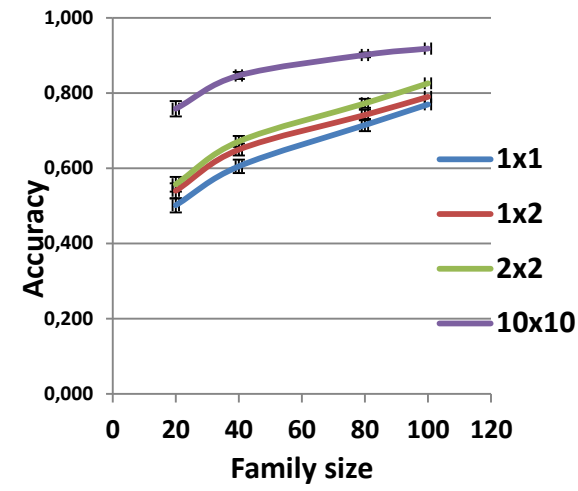
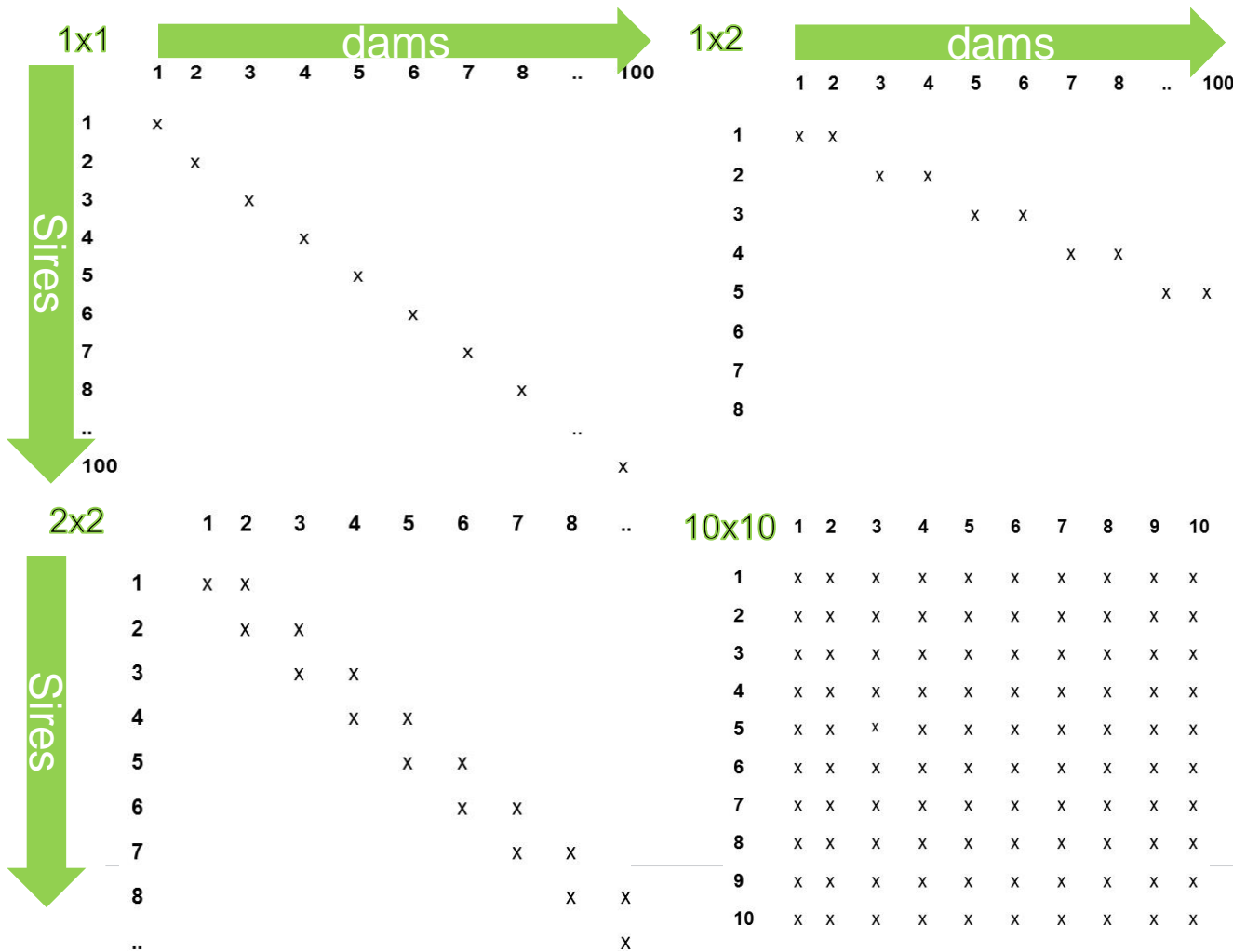
Using SNP chip genotype:

- › Heritability increased from 0.17 to 0.47
- › Almost doubling of accuracy and therefore genetic gain
- › 3,000 SNPs gave almost same benefit as 30,000
- › Accuracy very sensitive to size of family in test/training population.

LG	No SNPs	LG	No SNPs	LG	No SNPs
1	2061	11	1148	21	614
2	1034	12	1220	22	869
3	1560	13	1593	23	770
4	1277	14	1409	24	712
5	1309	15	1314	25	584
6	1317	16	985	26	574
7	855	17	695	27	884
8	202	18	977	28	609
9	1699	19	912	29	468
10	1537	20	1175		

30363 SNPs in total

Effects of mating design and family size



Fully factorial and => 20 sibs per family gave significantly highest accuracy

QTLs for PD resistance

- Identified 86 SNPs to be significantly associated with resistance to PD.
- The SNPs are located on 26 different linkage groups and distributed across 73 different genes.
- Gene expression study - resistant fish had significantly higher expression of genes with functions in immunity, response to inflammation and stress.
- Two strains- more than 30% of the genes identified also exhibited significant differences in transcript expression.

HIGH-DENSITY SNP MAPPING, QTL ANALYSIS AND TRANSCRIPTOME ASSESSMENT FOR RESISTANCE TO PANCREAS DISEASE IN ATLANTIC SALMON

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QTLs for SAV resistance

Results reflect earlier challenge test results

- › 2010G year class
- › Heritability of 0.35
- › QTLs on same linkage groups found

ORIGINAL ARTICLE



Salm Breed

Mapping and validation of a major QTL affecting resistance to pancreas disease (salmonid alphavirus) in Atlantic salmon (*Salmo salar*)

S Gonen^{1,7}, M Baranski^{2,7}, I Thorland³, A Norris⁴, H Grove⁵, P Arnesen⁴, H Bakke⁶, S Lien⁵, SC Bishop¹ and RD Houston¹ *Heredity* advance online publication, 20 May 2015

So, what can we expect...?

- › Genomic selection can double the accuracy with which we select broodstock for PD resistance = gains in survival to PD in a challenge test.
- › Need to reconsider practical issues around mating design and numbers of sibs in challenges to make genomic selection more efficient.
- › Can reduce number of SNPs needed significantly – move to sequencing platform
- › Validation of this challenge test to field mortality/morbidity would provide comfort.



Serap Gonan, Ross Houston, Steve Bishop.



Theo Meuwissen, Kahsay Nirea .



Anna Sonesson, Matt Baranski, Kahsay Nirea .



Håvard Bakke



Roy Hjelmeland, Janne Kristin Engdal Øvretveit.

